

VERTICAL DISTRIBUTION OF FISH WITHIN A TURBINE AT JOHN DAY DAM

Research Summary TSP-06-01

Preliminary Technical Proposal

August 2006

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Prepared for

***U. S. ARMY USACE OF ENGINEERS
WALLA WALLA DISTRICT***

201 North Third Avenue
Walla Walla, Washington 99362

Prepared by

NORMANDEAU ASSOCIATES, INC.

40 Cascade Ave.
Stevenson, Washington, 98648
(509) 427-4793

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1.0 INTRODUCTION/BASIC INFORMATION

Normandeau Associates, Inc. (Normandeau) is pleased to submit this preliminary proposal in response to the Research Summary issued by the U.S. Army Corps of Engineers (USACE), Walla Walla, Washington on 24 July, 2006. Normandeau Associates will undertake and complete the objectives of describing the vertical distribution of fish within a turbine with hydroacoustic technology at John Day Dam (TDP-06-01).

Normandeau understands that the work for 2007 will be to collect critical information at the USACE's John Day Dam for its turbine survival program. Our response seeks to address the objectives identified in the Research Summary for the study period of Spring/Summer, 2007.

A. TITLE OF PROJECT

Vertical Distribution of Fish within a Turbine at John Day Dam

B. PROJECT LEADERS

Dilip Mathur, Ph.D., Principal-in-Charge
Normandeau Associates, Inc.
P.O. Box 10
1921 River Road
Drumore, PA 17518
717-548-2121

Michael Hanks, Principal Investigator
Normandeau Associates, Inc.
P.O. Box 1159
40 Cascade Avenue
Stevenson, Washington 98648
509-427-4793 x12

John Skalski, Ph. D., Project Statistician
University of Washington
1325 Fourth Avenue, Suite 1820
Seattle, WA 98101
(206) 616-4851

1.1 C. STUDY CODES

TSP-06-01

1.2 D. DURATION

1 January 2007 – 31 December 2007

1.3 E. DATE OF SUBMISSION

August 2006

2.0 RESEARCH PROJECT SUMMARY

Our team will use scientific acoustic techniques to address the following study objectives:

- Determine the vertical distribution of run of the river fish entering a turbine distributor for three operating discharges.

Our proposed methodology uses focused acoustic transducers with low side lobes. Transducers will be mounted in the area of the wicket gates and oriented vertically in order to sample the vertical distribution of passing fish. The exact location and method of installing transducers will be determined after consulting with Corps personnel.

3.0 PROJECT DESCRIPTION

3.1 Introduction/Background

Normandeau Associates performed survival and injury tests at John Day Dam in 2006 to determine optimum turbine discharge levels (Normandeau Associates, in press). It was found that the highest discharge level had the lowest injury rates. The highest discharge level corresponds with the creation of an “open geometry” within the turbine. An open geometry is the best possible alignment of stay vanes and wicket gates combined with runner blade angles to produce the lowest turbulence and shear within the turbine environment.

Whether smolts migrating in deeper water within the range of depths at John Day Dam are subject to different survival probabilities and injury rates than surface acclimated fish is unknown and is a key objective of TSP-06-01 (Ferguson et al. 2005). Information on the vertical distribution of fish within the turbine may be used in the future to assist the Corps in making operational or structural changes that may increase survival rates of turbine passed fish.

3.1.1 SPECIFIC OBJECTIVES

Objectives of the hydroacoustic monitoring of fish passage at Lower Monumental Dam will be to:

- Estimate the vertical distribution of run of the river fish entering a turbine distributor for three operating discharges.

3.2 SPECIFIC METHODOLOGY

3.2.1 Transducer Deployment

Our proposed methodology uses focused acoustic split-beam transducers with low side lobes. Transducers will be mounted in the area of the wicket gates and oriented vertically in order to sample the vertical distribution of passing fish. The exact location and method of installing transducers will be determined after consulting with Corps personnel.

3.2.2 Statistical Approach

The statistical analysis of distribution patterns between treatments will be arranged in conjunction with our project statistician, Dr. John Skalski.

3.2.3 Data Analysis

Depending on the volume of data, we will either manually track all data files or we will use an auto-tracker. If we use an auto-tracker all data files will be played through a trace formation program. We will evaluate whether a 2-dimensional model or a 4-dimensional (XYZ/Time) tracking model will perform best on the split-beam data. Tracking parameters used by the automated program will be verified in part by manual analysis with a visual trace formation program. The date/time, mean range, echo level, and slope of each target detected by the single-beam systems will be written to file, along with a host of other descriptive measurements; mean Target Strength (TS), direction of travel, and fish velocity will be provided by split-beam systems. Fish direction will be expressed in the XY plane, represents a plane parallel to the reservoir surface. The YZ plane corresponds to a cross-sectional plane, while the XZ plane is vertical and parallel to the dam axis: both data sets are available if required. XY trajectories describe movement toward, along, or away from the structure in a plan view, while the YZ path provides an indication of the fish trajectory in a cross-sectional plane. Direction of travel in the XY direction will be calculated for each detected fish; XZ and YZ data will be available if requested.

Area expansion will be based on a per-fish weighting factor, calculated from echo sounder ping rate, number of echoes, specific trajectory parameters, and other values that affect detectability. Total passage for a sample period is the sum of these weighting factors. The use of *in-situ* based detectability parameters will minimize or eliminate biases that might corrupt any ratio-based estimator.

3.2.4 Treatments

We will examine the effects of differing turbine discharge levels on vertical fish distributions. Ideally, we will have discrete and sustainable discharge levels during the smolt outmigration. However, more likely the data will be collected over the specified period and grouped posteriori into different discharge levels.

3.2.5 Limitations of Proposed Methodology and Expected difficulties

We are not aware of similar installations in previous studies. We may find difficulties with the acoustic environment, but will attempt to alleviate those with aiming angles and sound impulse configuration. Clear and timely communication between Normandeau Associates, diving contractors, and the USACE will be essential. We have successfully worked with Corps personnel at mainstem hydroelectric projects throughout the Columbia River Basin and do not expect any problems with communications. A potential exists for interference with instruments and cable routing related to other experiments. These conflicts have been easily resolved in past years.

3.2.6 Expected Results and Applicability

Information on the vertical distribution of fish within the turbine may be used in the future to assist the Corps in making operational or structural changes that may increase survival rates of turbine passed fish.

3.2.7 Schedule

The schedule for the John Day Dam deployment, data collection, and reporting will be established in consultation with USACE biologists and project personnel. Prior to commencement of the project, a planning meeting will be held with USACE personnel. Preparation and system calibration will take place immediately prior to delivery to the site.

Data processing will be accomplished in the field, and verification of analysis, results summarization, and report writing will be conducted at Normandeau Associates offices. All methods and results will be incorporated into a comprehensive report relaying study methods, results, and conclusions. Reports and presentations will be delivered according to the schedule detailed in the USACE Scope of Work.

3.2.8 Quality Control

Normandeau Associates prides itself on its quality control measures and reliability of data collection and analysis procedures, as well as those of its subcontractors. We maintain rigorous quality assurance programs during all aspects of operations in the field, especially during data collection and analysis. All personnel are rigorously trained in the operation of the systems for which they retain responsibility. Quality control measures will include:

- Calibrate all acoustic systems before installation.
- Develop a hardcopy of visual acoustic patterns for each transducer, display at the site of the remote access portal for comparison purposes.
- Determine the magnitude of observed deviations that will indicate changes in aim or calibration.
- Document all procedures for data collection, short/long term archiving.
- Document all analytical steps: thresholding, echo formation, trace formation, filtering, area and time weighting.
- Data sets from each transducer shall be analyzed within the first few days of data collection and weekly thereafter to insure accuracy of data collection and analysis parameters.
- Spare transducers and cables will be stored on site during the study to insure timely replacement of failed components. A spare computer will be stored on site during the study.
- A field log shall be maintained at the remote access portal site for each system.
- We will endeavor to maintain continuity in all project personnel and all remote access procedures.

3.3 Facilities and Support Required

For the study at John Day Dam, the USACE will provide the transducer-mounting structure. If needed, Normandeau Associates will provide any additional required transducer mounts. Also, we will lease or supply all networking components, the Project Master Control computer, and any other needed equipment. Normandeau Associates will require the use of an appropriate space to locate our sounders and computer.

If available for this project, the USACE will provide Precision Acoustic Systems (PAS) scientific sounders, multiplexers, and transducers as well as transducer cables, communication cables, and data acquisition computers. If USACE-owned acoustic gear is not available, Normandeau Associates will lease or otherwise procure the necessary acoustic gear, at the request and approval of the USACE.

3.4 Impacts on Project Operation and on Other Research

3.4.1 Other Research

We plan to coordinate closely with other researchers to assure that sampling efforts are complementary with any other research conducted at John Day Dam in 2007.

3.4.2 Installation of Equipment

Cables from the acoustic transducers must be routed from the transducer location to the echo sounder. These cables may be routed some distance from the location where the transducer is located.

The methodologies proposed for 2007 may include remote access to the acoustic systems. This capability will require that the overflow room have either 1 phone line and high speed internet access, or two phone lines. Installation of these capabilities will cause minor impacts to project personnel as they review, advise, or implement these capabilities. The operation of electronics inside the instrumentation room would benefit by incorporation of some type of air conditioning during the summer portions of the studies. An alternative to providing air conditioning for the entire room is to build an environment enclosure inside the room that has some form of air conditioning supplied to it.

3.5 Project Data Collection

Previous studies have required that Project Operations data be provided. This has been accomplished by daily emails containing operations files attached and sent by the operators. If access to the automated operations system can be provided, we can automate the collection of the operational data.

3.6 Collaborative Arrangements

The project team draws upon the expertise of a statistical consultant Dr. John Skalski for design and review of the statistical aspects of the proposed studies. We anticipate using the same consultant as in previous years.

In addition, we may arrange to team with other firms with hydroacoustic expertise such as Hydroacoustic Technology, Inc. or Biosonics, Inc. These details will be arranged during preparation of the final proposal.

4.0 LIST OF KEY PERSONNEL AND PROJECT DUTIES

Dilip Mathur, Ph.D. is the overall program manager for the ID/IQ professional services contract with the Walla Walla District. He is well acquainted with the Corps biological goals and has a thorough understanding of the issues in the Columbia and Snake River Basins. Dr. Mathur brings over 35 years of experience in managing multidisciplinary research and environmental projects for both public and private sector clients. He has worked with the Corps over the last 10 years completing various task orders under existing contracts. His expertise lies in the fields of thermal discharges, anadromous fish passage and restoration, fish behavior, integration of fish data with power plant operations, turbine and non-turbine passage survival of fishes, turbine and spillway rehabilitation relative to friendlier fish passage, delineation of effects of power plants on aquatic ecosystems, fisheries biology, data analysis and population dynamics.

Mr. Michael Hanks will serve as the project manager for this task order and will be the principal investigator. Mr. Hanks has over twelve years experience in the planning and management of large and small studies that used acoustic methods to sample fish presence and behavior, and to measure water velocity and flow discharge. He has been a key contributor to large-scale fixed-aspect hydroacoustic studies at mainstem Columbia River dams as well as smaller studies that linked fish behavior with hydraulic components in the forebays of dams and at surface collection entrances. Normandeau Associates will provide Technical support, administration/management and oversight for this project, and report review.

Mr. Robert McDonald will assist the project manager for this task order. Mr. McDonald has over 15 years of experience conducting biological evaluations at hydroelectric projects. He has overseen, as project manager, large hydroacoustic and acoustic telemetry projects conducted at Rock Island Dam

and elsewhere. He has extensive experience budgeting and meeting the logistical demands of large biological and hydroacoustic studies. He will assist the project manager in all aspects of the planning and conduct of the proposed evaluation.

Mr. George Nardacci will assist with project administration and interactions with USACE contract and purchasing personnel. Mr. Nardacci has 10 years experience in working closely with USACE staff to successfully administer numerous and complex projects over a broad range of study areas.

5.0 TECHNOLOGY TRANSFER

Information acquired during the proposed work will be transferred in the form of written and oral research reports. A draft report will be submitted on October 31, 2007. A presentation will be made at the Corps' annual Anadromous Fish Evaluation Program Review in November 2007. A draft final report will be provided to the USACE by December 31, 2007, and the final report will be completed 30 days after review comments are received. Technology transfer activities may also include presentation of research results at regional or national fisheries symposia and publication of results in scientific journals.

6.0 REFERENCES

Ferguson, J.W. et al. 2005. Passage of adult and juvenile salmonids through federal Columbia River power system dams. U.S. Dept. Commer., NOAA Tech. Memo. NMFS_NWFSC-64, 160 p.

Normandeau Associates, Inc. and J.R. Skalski. 2006. Determination of direct injury and survival of salmonids in turbine passage at John Day Dam 2006. In press.